

WHAT IS CLAIMED IS:

1 1. A computer implemented diagnostic tool for automatically diagnosing a system
2 by:
3 determining a path in the storage system to test, wherein the path includes path
4 components including at least a host adaptor, a link, a device interface, and a device;
5 performing an initial test to determine if there is a failure in the path;
6 adding at least one of the path components to a suspect list capable of being a cause of
7 the failure, wherein the suspect list is implemented in a computer readable data structure;
8 performing at least one isolation test on at least one of the path components added to
9 the suspect list;
10 removing the tested path component from the suspect list if the isolation test confirms
11 that the tested path component cannot be a source of the failure; and
12 returning the suspect list to a user to provide information on the path components
13 capable of being the cause of the failure.

1 2. The method of claim 1, wherein the initial test comprises a test of the path, and
2 wherein path components are added to the suspect list and isolation tested after the initial test
3 indicates a path failure.

1 3. The method of claim 1, wherein the initial test comprises a test of the path, and
2 wherein path components are added to the suspect list and isolation tested after the initial test
3 indicates no path failure to provide additional testing of the path components.

1 4. The method of claim 1, wherein isolation testing the host adaptor comprises:
2 generating output to instruct the user to disconnect the host adaptor from the link,
3 wherein the isolation test is performed on the host adaptor after the user provides input

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4 indicating that the host adaptor was disconnected, wherein the host adaptor is removed from
5 the suspect list if the host adaptor passes the diagnostic test.

1 5. The method of claim 4, further comprising:
2 generating output to instruct the user to replace the link if the host adaptor passes the
3 test;
4 performing a link isolation test on the path with the new link; and
5 removing path components from the suspect list if the link isolation test on the replaced
6 link indicates that the link was one cause of the failure.

1 6. The method of claim 5, wherein if the link isolation test indicates that the link is
2 not one cause of the failure, further performing:
3 removing the link from the suspect list;
4 generating output to instruct the user to reinstall the previously replaced link; and
5 performing a device interface isolation test of the device interface.

1 7. The method of claim 6, further comprising:
2 generating output to instruct the user to disconnect the device interface from the link to
3 allow for isolation testing of the device interface.

1 8. The method of claim 6, wherein if the device interface isolation test indicates
2 that the device interface is not one cause of the failure, further performing:
3 removing the device interface from the suspect list; and
4 performing a device isolation test of the device.

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1 9. The method of claim 1, wherein performing the isolation testing of the host
2 adaptor and device interface comprises additional isolation testing of field replaceable units
3 within the host adaptor and device interface.

1 10. The method of claim 1, further comprising:
2 determining whether the path components include at least one switch, device port,
3 initiator port, and links therebetween, wherein the host adaptor connects through a initial link to
4 an initiator port on the switch and the device interface connects through a second link to a
5 device port on the switch; and
6 performing isolation testing on the switch, device port, initiator port, and the first and
7 second links if the path includes the switch.

1 11. The method of claim 1, further comprising:
2 receiving input from the user indicating a level of testing, wherein the extent of the
3 isolation tests are determined by the user indicated testing level.

1 12. The method of claim 1, wherein the device comprises a storage system.

1 13. The method of claim 12, wherein the storage system comprises storage areas,
2 further comprising:
3 receiving input from the user indicating storage areas to test in the storage system,
4 wherein the isolation tests on the storage system are performed with respect to those storage
5 areas indicated by the user.

1 14. The method of claim 12, wherein the storage system adheres to the Fibre
2 Channel protocol and architecture and the link comprises an optical fiber wire.

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1 15. The method of claim 1, wherein the system is capable of including different
2 types of host adaptors and device interfaces, wherein there is a separate isolation test for each
3 of the different types of host adaptors and device interfaces that are capable of being included
4 in the system, and wherein performing an isolation test with respect to one host adaptor or
5 device interface comprises:

6 determining a type of the host adaptor or device interface; and
7 performing the isolation test for the determined type of host adaptor or device interface.

1 16. A system for automatically diagnosing a storage system, comprising:

2 (a) a storage system includes a plurality of path components comprising:

3 (i) a host adaptor;

4 (ii) a link;

5 (iii) a device interface; and

6 (iv) a device; and

7 (b) a processor;

8 (c) a computer readable medium accessible to the processor;

9 (d) a suspect list embedded in the computer readable medium; and

10 (e) a diagnostic software embedded in the computer readable medium capable of
11 causing the processor to perform:

12 (i) performing an initial test to determine if there is a failure in the path;

13 (ii) adding at least one of the path components to the suspect list capable of
14 being a cause of the failure;

15 (iii) performing at least one isolation test on at least one of the path components
16 added to the suspect list;

17 (iv) removing the tested path component from the suspect list if the isolation test
18 confirms that the tested path component cannot be a source of the failure; and

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19 (v) returning the suspect list to a user to provide information on the path
20 components capable of being the cause of the failure.

1 17. The system of claim 16, wherein the initial test comprises a test of the path, and
2 wherein path components are added to the suspect list and isolation tested after the first test
3 indicates a path failure.

1 18. The system of claim 16, wherein the first test comprises a test of the path, and
2 wherein path components are added to the suspect list and isolation tested after the first test
3 indicates no path failure to provide additional testing of the path components.

1 19. The system of claim 16, wherein isolation testing the host adaptor comprises:
2 generating output to instruct the user to disconnect the host adaptor from the link,
3 wherein the isolation test is performed on the host adaptor after the user provides input
4 indicating that the host adaptor was disconnected, wherein the host adaptor is removed from
5 the suspect list if the host adaptor passes the diagnostic test.

1 20. The system of claim 19, wherein the diagnostic tool software is further capable
2 of causing the processor to perform:
3 generating output to instruct the user to replace the link if the host adaptor passes the
4 test;
5 performing a link isolation test on the path with the new link; and
6 removing path components from the suspect list if the link isolation test on the replaced
7 link indicates that the link was one cause of the failure.

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1 21. The system of claim 20, wherein if the link isolation test indicates that the link is
2 not one cause of the failure, then the diagnostic tool software is further capable of causing the
3 processor to perform:

4 removing the link from the suspect list;
5 generating output to instruct the user to reinstall the previously replaced link; and
6 performing a device interface isolation test of the device interface.

1 22. The system of claim 21, wherein the diagnostic tool software is further capable
2 of causing the processor to perform

3 generating output to instruct the user to disconnect the device interface from the link to
4 allow for isolation testing of the device interface.

1 23. The system of claim 21, wherein if the device interface isolation test indicates
2 that the device interface is not one cause of the failure, further performing:

3 removing the device interface from the suspect list; and
4 performing a device isolation test of the device.

1 24. The system of claim 16, wherein performing the isolation testing of the host
2 adaptor and device interface comprises additional isolation testing of field replaceable units
3 within the host adaptor and device interface.

1 25. The system of claim 16, wherein the diagnostic tool software is further capable
2 of causing the processor to perform:

3 determining whether the path components include at least one switch, device port,
4 initiator port, and links therebetween, wherein the host adaptor connects through a first link to

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5 an initiator port on the switch and the device interface connects through a second link to a
6 device port on the switch; and
7 performing isolation testing on the switch, device port, initiator port, and the first and
8 second links if the path includes the switch.

1 26. The system of claim 16, wherein the diagnostic tool software is further capable
2 of causing the processor to perform:

3 receiving input from the user indicating a level of testing, wherein the extent of the
4 isolation tests are determined by the user indicated testing level.

1 27. The system of claim 16, wherein the device comprises a storage system.

1 28. The system of claim 27, wherein the storage system comprises storage areas,
2 wherein the diagnostic tool software is further capable of causing the processor to perform:

3 receiving input from the user indicating storage areas to test in the storage system,
4 wherein the isolation tests on the storage system are performed with respect to those storage
5 areas indicated by the user.

1 29. The system of claim 27, wherein the storage system adheres to the Fibre
2 Channel protocol and architecture and the link comprises an optical fiber wire.

1 30. The system of claim 16, wherein the system is capable of including different
2 types of host adaptors and device interfaces, wherein there is a separate isolation test for each
3 of the different types of host adaptors and device interfaces that are capable of being included
4 in the system, and wherein performing an isolation test with respect to one host adaptor or
5 device interface comprises:

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6 determining a type of the host adaptor or device interface; and
7 performing the isolation test for the determined type of host adaptor or device interface.

1 31. An article of manufacture for implementing a diagnostic tool for automatically
2 diagnosing a system, wherein the diagnostic tool is embedded in a computer readable medium
3 and includes code capable of causing a processor to perform:

4 determining a path in the storage system to test, wherein the path includes path
5 components including at least a host adaptor, a link, a device interface, and a device;

6 performing an initial test to determine if there is a failure in the path;

7 adding at least one of the path components to a suspect list capable of being a cause of
8 the failure, wherein the suspect list is implemented in a computer readable data structure;

9 performing at least one isolation test on at least one of the path components added to
10 the suspect list;

11 removing the tested path component from the suspect list if the isolation test confirms
12 that the tested path component cannot be a source of the failure; and

13 returning the suspect list to a user to provide information on the path components
14 capable of being the cause of the failure.

1 32. The article of manufacture of claim 31, wherein the initial test comprises a test
2 of the path, and wherein path components are added to the suspect list and isolation tested after
3 the initial test indicates a path failure.

1 33. The article of manufacture of claim 31, wherein the initial test comprises a test
2 of the path, and wherein path components are added to the suspect list and isolation tested after
3 the initial test indicates no path failure to provide additional testing of the path components.

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1 34. The article of manufacture of claim 31, wherein isolation testing the host
2 adaptor comprises:
3 generating output to instruct the user to disconnect the host adaptor from the link,
4 wherein the isolation test is performed on the host adaptor after the user provides input
5 indicating that the host adaptor was disconnected, and wherein the host adaptor is removed
6 from the suspect list if the host adaptor passes the diagnostic test.

1 35. The article of manufacture of claim 34, wherein the diagnostic tool code is
2 further capable of causing the processor to perform:
3 generating output to instruct the user to replace the link if the host adaptor passes the
4 test;
5 performing a link isolation test on the path with the new link; and
6 removing path components from the suspect list if the link isolation test on the replaced
7 link indicates that the link was one cause of the failure.

1 36. The article of manufacture of claim 34, wherein if the link isolation test indicates
2 that the link is not one cause of the failure, and wherein the diagnostic tool code is further
3 capable of causing the processor to perform:
4 removing the link from the suspect list;
5 generating output to instruct the user to reinstall the previously replaced link; and
6 performing a device interface isolation test of the device interface.

1 37. The article of manufacture of claim 36, wherein the diagnostic tool code is
2 further capable of causing the processor to perform:
3 generating output to instruct the user to disconnect the device interface from the link to
4 allow for isolation testing of the device interface.

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1 38. The article of manufacture of claim 36, wherein if the device interface isolation
2 test indicates that the device interface is not one cause of the failure, further performing:
3 removing the device interface from the suspect list; and
4 performing a device isolation test of the device.

1 39. The article of manufacture of claim 31, wherein performing the isolation testing
2 of the host adaptor and device interface comprises additional isolation testing of field
3 replaceable units within the host adaptor and device interface.

1 40. The article of manufacture of claim 31, wherein the diagnostic tool code is
2 further capable of causing the processor to perform:
3 determining whether the path components include at least one switch, device port,
4 initiator port, and links therebetween, wherein the host adaptor connects through a initial link to
5 an initiator port on the switch and the device interface connects through a second link to a
6 device port on the switch; and
7 performing isolation testing on the switch, device port, initiator port, and the first and
8 second links if the path includes the switch.

1 41. The article of manufacture of claim 31, wherein the diagnostic tool code is
2 further capable of causing the processor to perform:
3 receiving input from the user indicating a level of testing, wherein the extent of the
4 isolation tests are determined by the user indicated testing level.

1 42. The article of manufacture of claim 31, wherein the device comprises a storage
2 system.

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1 43. The article of manufacture of claim 42, wherein the storage system comprises
2 storage areas, wherein the diagnostic tool code is further capable of causing the processor to
3 perform:

4 receiving input from the user indicating storage areas to test in the storage system,
5 wherein the isolation tests on the storage system are performed with respect to those storage
6 areas indicated by the user.

1 44. The method of claim 1, wherein the system is capable of including different
2 types of host adaptors and device interfaces, wherein there is a separate isolation test for each
3 of the different types of host adaptors and device interfaces that are capable of being included
4 in the system, and wherein performing an isolation test with respect to one host adaptor or
5 device interface comprises:

6 determining a type of the host adaptor or device interface; and
7 performing the isolation test for the determined type of host adaptor or device interface.

1 45. A computer readable medium including data structures used to perform
2 diagnostic testing of a system, comprising:

3 a rule object including code defining a flow of operations to perform diagnostic testing
4 of a path in the system, wherein the path includes path components including at least a host
5 adaptor, a link, a device interface, and a device, wherein the rule object calls test descriptors
6 associated with a testing operation to perform;

7 a test descriptor object including test descriptors, wherein each test descriptor specifies
8 one or more program modules to perform the testing operation associated with the test
9 descriptor; and

10 a module object including program modules providing code to perform testing
11 operations, wherein a call to one test descriptor executes the program modules specified by the

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12 test descriptor to perform diagnostic testing operations according to the operation flow
13 specified in the rule object.

1 46. The computer readable medium of claim 45, wherein multiple program modules
2 call at least one library module to perform diagnostic related operations performed within the
3 multiple program modules.

1 47. The computer readable medium of claim 46, further comprising a suspect list
2 data structure indicating path components capable of being a source of a failure in the tested
3 path, wherein the rule object includes code to add path components capable of being a source
4 of the failure to the suspect list and removes path components from the suspect list that are
5 determined not to be capable of being the source of the failure..

1 48. The computer readable medium of claim 46, wherein the flow of operations
2 defined in the rule object comprises:
3 calling a first test descriptor, wherein the first test descriptor specifies at least one
4 program module to determine if there is a failure in the path;
5 adding at least one of the path components to the suspect list that is capable of being a
6 cause of the failure;
7 calling at least one isolation test descriptor associated with at least one of the path
8 components added to the suspect list, wherein the isolation test descriptor specifies at least one
9 program module to determine if there is a failure in the path component associated with the
10 called isolation test descriptor;
11 removing the path component from the suspect list if the isolation test defined by the
12 called isolation test descriptor confirms that the tested path component cannot be a source of
13 the failure; and

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14 returning the suspect list to a user to provide information on possible failed components

15 in the tested path.

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